Total Solar Eclipse

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Mission Objective:

- Our mission objective was to capture the total solar eclipse that occurred on August 21, 2017.
- To assemble all the payloads (video, still image and Iridium) and the ground station tracking system.
- To determine and implement the pointing solutions for the video camera to point the sun.
- To stabilize the structure of the payload, preventing it from twisting/rotating.

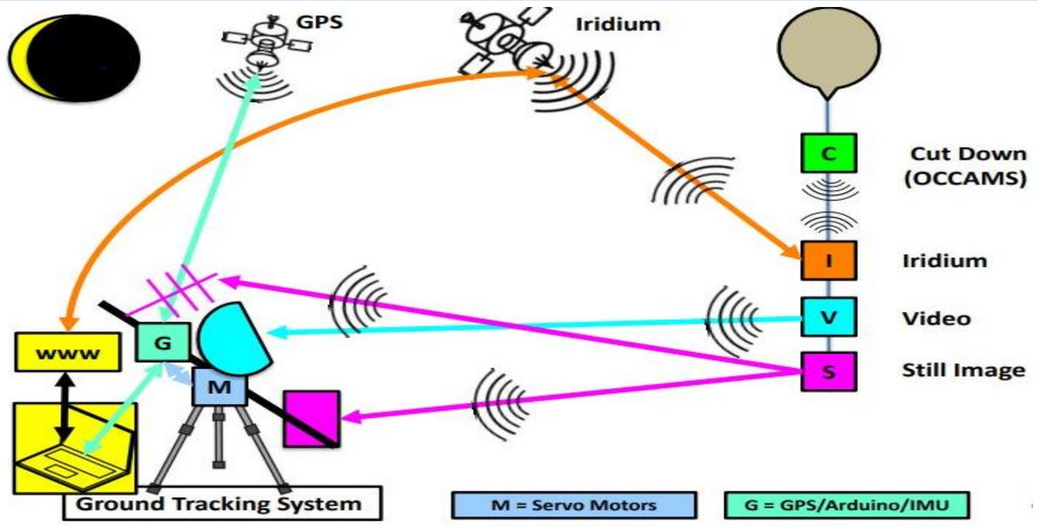

Figure1: Functional Block Diagram

Video Payload:

- The video payload consists of a Raspberry Pi video camera, an UBIQUITI M5 modem, camera housing, 3.7V Lithium batteries.
- The streaming video payload system would capture video of the eclipse during the balloon flight and process the video transmission.
- The payload would then transmit the video to the ground station continuously, throughout the flight.
- Local Area Network is set to Static IP address, video payload is then connected to the ground station computer using PuTTY.
- The video is then streamed using the VLC media player.

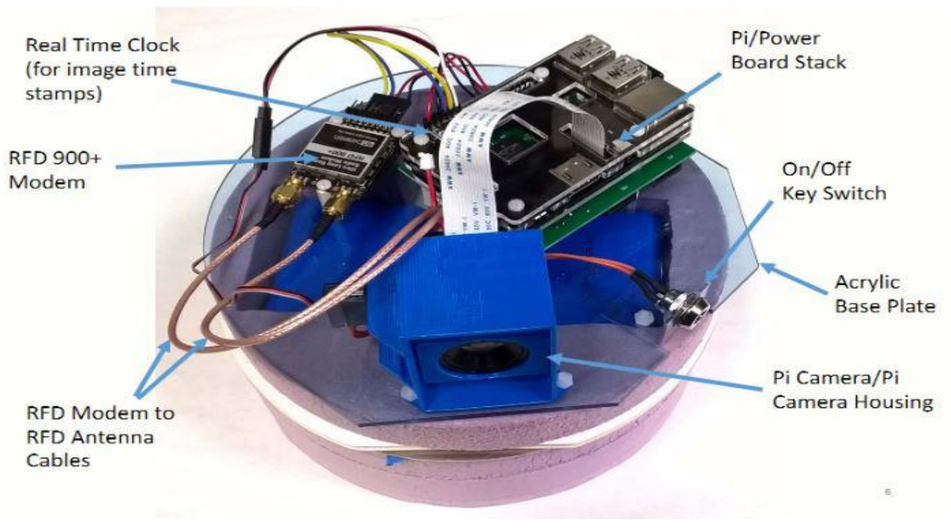

Figure3: Completed Still Image Payload

Iridium Payload:

- The Iridium satellite modem is used for tracking the payload and to transmit the remote commands to the payload from the ground station.
- This system consists of an OCCAMS board, 3.7V lithium battery, two antennae and a NAL Research Iridium Modem 9602-LP.
- The Iridium system will allow us to track the balloon in real-time with approximately 30 seconds between GPS packets.
- The attached OCCAMS can also transmit the status of the payload back down to the ground station through the use of four status bits.

Ground Station:

- The ground station includes a Yagi antenna, a Dish, RFD900 Radio, M5 Radio, IMU, a Patch antenna, Elevation & Azimuth servo, Arduino/GPS, a tripod and a Laptop.
- The ground station tracking system was used for all aspects of the Solar Eclipse balloon flight such as receiving still images, receiving video, receiving balloon location, transmitting cut down command and uploading the images/video to the web.
- Each team built their own ground station which was tested for full functionality.
- The ground station was set to face the true north at the initial stage, and then servos are levelled to zero using Micro Maestro Servo Controller.

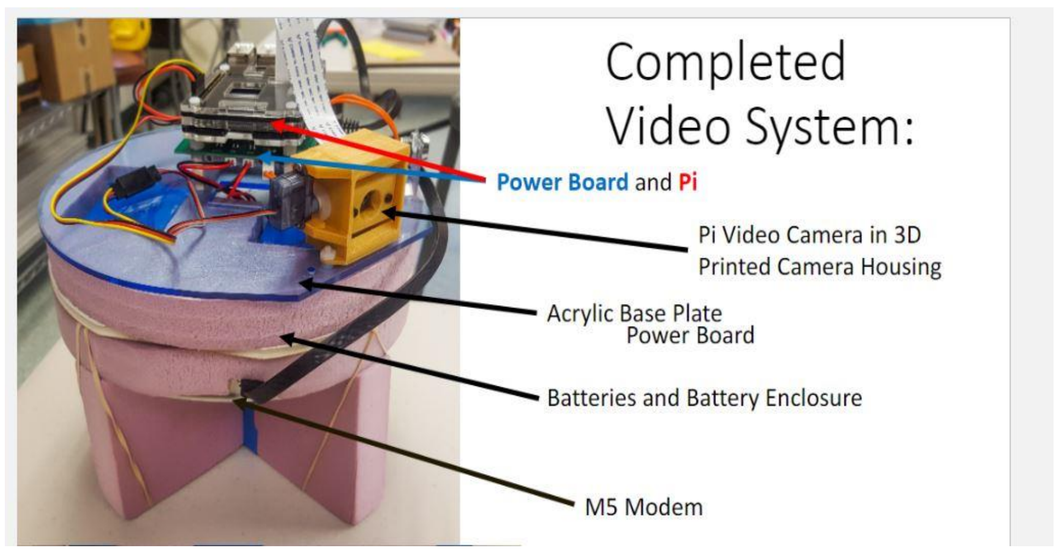

Figure2: Completed Video Payload

Still Image Payload:

- The RFD900 Still Image payload allows to record and transmit the still images to the ground station.
- Still image payload has a Raspberry Pi camera, camera housing, RFD900 modem, Real Time Clock and 3.7V Lithium batteries.
- The Pi camera can perform one task at a time and controlled using a GUI.
- The Pi camera is programmed to take and store pictures on the memory card, in such a way it takes a new image for every 60 seconds.
- The most recent image can be requested to download or a single image can be picked from a list of all the saved images.

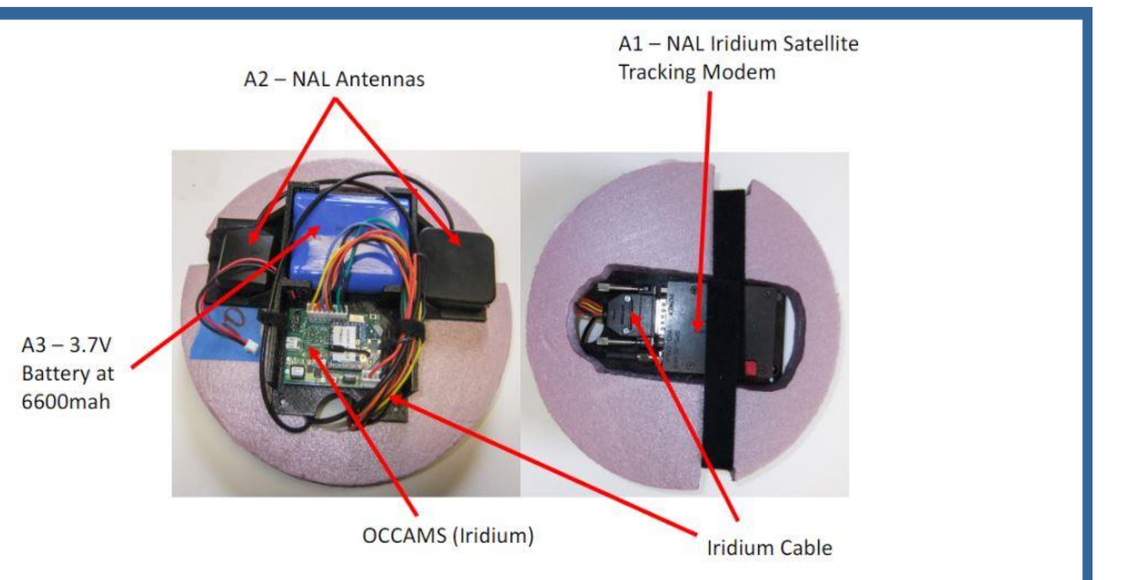

Figure4: Completed Video Payload

Conclusion:

The project was successfully completed, under the guidance of Dr. Jani Macari Pallis. The University of Bridgeport team also launched Radiosondes (weather balloons) during the eclipse totality to calculate the temperature, pressure, wind speed, etc., from the atmosphere. Many thanks to Connecticut Space Grant for its support!